

• COLORADO RIVER •
AQUEDUCT NEWS

THE METROPOLITAN WATER DISTRICT

OF SOUTHERN CALIFORNIA



Vol. V

AUGUST 15, 1938

No. 15



MT. SAN JACINTO

Holding its head high in the clouds, this proud peak wages a valiant but losing fight against hard-rock crews who hour by hour drive forward the Aqueduct's 13-mile San Jacinto Tunnel.

SAN JACINTO TUNNEL ISSUE

COLORADO RIVER
AQUEDUCT NEWS
 THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

306 WEST THIRD ST.
 LOS ANGELES, CALIFORNIA

Published twice monthly in the interest
 of Field and Office Workers on the Colorado River Aqueduct, and for the information of all other citizens of the Metropolitan Water District.

Vol. V. August 15, 1938 No. 15.

Cabazon-Lawrence Holed Through on July 28

Closing the firing switch at exactly 10:28 P. M. on July 28, General Superintendent B. C. "Mike" Leadbetter set off the final round which blasted out the remaining 21-foot rock barrier in the Cabazon-Lawrence leg of the 13-mile San Jacinto tunnel.

The resulting series of dynamite explosions which rumbled down the tunnel was a fitting climax to the excavation of the eastern section of the tunnel on which work had been started at the Cabazon shaft five years before and five miles away from that firing switch.

Less than 4,600 feet of the 68,843-foot tunnel now remains to be excavated. This rapidly shortening plug is between the Lawrence adit and the Potrero shaft. A clear picture of the relationship of these headings to the rest of the tunnel is shown on the drawing on pages 6 and 7 of this issue of the NEWS.

At 5:00 A. M. on the morning of the hoing through, 45 feet remained to be driven between the Cabazon and Lawrence headings. Supt. John Austin's Lawrence crews poked a test hole through this barrier and yelled a polite "yoo-hoo" over to Cabazon. Disdaining this friendly greeting, the Cabazoneers, Supt. "Tim" Sides at the switch, blasted off a 9-foot section of the rock at 6:15 A. M.

With their feelings just a little hurt, the Lawrenceites retaliated and knocked off another 7 feet at 9:40 A. M., only to have Cabazon shoot the works at 3:00 P.M. and whittle the barrier down to 21 feet. The "spirit of good fun" having checked out with the last blast, both crews hitched up their collective belts and went to work with a vengeance to decide just who was going to hole through "this here now tunnel."

About this time, Supt. Leadbetter snared the forlorn dove of peace from

(Continued on Page 12)



Lawrence adit crews go to work on the pile of muck which, five minutes before this picture was taken, was the last 21 feet of rock in the east section of the San Jacinto tunnel. A member of the Cabazon crew is seen looking over the top of the muck pile just to the right of one of the men barring down rock fragments.

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A THIRTEEN MILE FIGHT

By Lynn Davis Smith

Personal satisfaction in being able to exhibit his work to his fellow man is the greatest reward that the average craftsman receives for his labor. However, for the hard-rocker who helps drive a difficult tunnel, this personal satisfaction is most accurately described by the expression, "knowledge of a good job, well done."

Unfortunately, mankind has a habit of applauding only that which he can see. The work of the artist, or the poet, or the bridge-builder, receives the acclaim of generation after generation. The tunneler's work is forever hidden—and is usually forgotten.

For hundreds of years, people from all over the world have made pilgrimages to a hill in Athens to see the crumpled ruins of the Parthenon—worthless today—and yet accepted as the finest example of the greatness of ancient craftsmen.

Under the ground, and not far from that hill, is the Hadrian Aqueduct, sixteen miles of tunnels, which are almost as old as the Parthenon. In spite of the fact that the very life of Athens has depended upon those tunnels—that aqueduct having been the principal source of water for the city for the past 1800 years—they were forgotten, and until 1924 their location had been unknown for more than three hundred years.

On the center pages of this issue of the NEWS is a plan and profile drawing of the 13-mile San Jacinto tunnel, one of the links in the Colorado River Aqueduct, which is considered one of the most difficult tunnels that has ever been constructed. As shown on the drawing, more than 12 miles of that tunnel have been driven, and less than 4600 feet remain to be excavated.

What the drawing fails to do, however, is to indicate the unending fight that the hard-rockers have carried on against the forces of that mountain in order to beat their way through each of the 64,264 (August 7, 1938) feet of that tunnel that they have already penetrated.

The San Jacinto tunnel is one of 38 major tunnels on the Colorado River Aqueduct system. Totaling 108 miles in length, these have constituted one of the biggest tunneling jobs in construction history. All of the other tunnels have been excavated, and the aqueduct as a whole is more than 85 per cent completed.

Much of the 392-mile aqueduct system has been constructed without strenuous opposition from the forces of Na-

ture. She seemed to concentrate most of her might at one point.

For her center of resistance, she chose Mt. San Jacinto. This spectacular peak, which, with its foot in the desert only 400 feet above sea level, rises to a sheer two miles into the air, is a fitting spot for a show-down fight between Man and Nature. For her principal weapon against Man, Nature chose the very thing that he will carry through that mountain—Water.

Because it is but one link in the aqueduct system, the San Jacinto tunnel had to fit into the general plan. Much study was given to its final location, including extensive core drilling. This core drilling, along with careful geologic studies, indicated difficult, but not impossible, tunneling ground, but the inherent limitations of such explorations could not indicate accurately the amount of water which might be encountered.

Bids for the construction of the tunnel were called for late in 1932, and on March 17, 1933, a contract was awarded to Wenzel & Henoch Construction Company.

Sinking of the Cabazon and Potrero shafts (see drawing) was started in May, 1933. These vertical shafts are circular and are 15 feet in diameter. The Cabazon shaft is 262 feet deep and is 935 feet north of the main tunnel line, being connected at the bottom with a cross drift 10 feet square.

This shaft was completed in August, 1933, and by February, 1934, the main tunnel was being excavated both east and west from the crosscut.

The Potrero shaft is 796 feet deep and intersects the main tunnel on center line. The first water was encountered at a depth of 130 feet and continued to flow at rates of from 30 to 250 gallons per minute until the bottom of the shaft was reached in April, 1934.

During the next eight months there were innumerable delays, and very little progress was made in driving the main tunnel. On three separate occasions the Potrero shaft was flooded, once to a height of 647 feet above the tunnel.

Finally, the District took over the work. Pointing out that the contractor had unreasonably and unnecessarily delayed the work, General Manager F. E. Weymouth issued an ouster order in January, 1935, and took possession of the job in February. At that time, it was estimated, the contractor was from seven months to a year behind schedule.

Most of the tunnel men who were working for the contractor were im-

mediately placed on the District's payroll, and since then the work has been carried forward as a force account job.

The contractor, a Wisconsin firm, brought suit against the District, but General Manager Weymouth's action was upheld by a United States District court judgement on March 30, 1938.

Immediately after taking over the tunnel work, the District began the construction of large capacity pumping facilities, both at Potrero and Cabazon. These consisted of large bottle-shaped chambers cut out of the solid rock adjacent to the two shafts. Batteries of pumps having a total capacity of 29,600 gallons per minute at Cabazon and 17,400 gpm at Potrero were installed in these chambers, which were closed off with heavy steel bulkheads.

Auxiliary controls on the surface were installed so that the pumps, in their water-tight chambers, could be operated even though the tunnel should be completely flooded. Large steel pipe lines ran from these stations to the tunnel headings, and, although on occasions both stations were pumping at close to their full capacity, the tunnel was never again full of water. These stations continued to operate until Cabazon holed through to the east portal and Potrero holed through to the west portal, after which the water was carried through the tunnel and out at the portals.

With adequate pumping facilities installed, the hard-rockers once more turned their attention to driving headings. The battle had just begun, and a perusal of the sheafs of the daily construction reports reveals that every day brought a new problem which affected every man on the job—all the way down, general superintendent, shaft superintendents, walkers, shifters, underground men and top men—each had his ingenuity and will power taxed by the unrelenting fight with the old man of the mountain.

Work goes on in the tunnel twenty-four hours a day, seven days a week, the two exceptions being Christmas and the Fourth of July.

Midday and Midnight are the same underground, where electricity provides the only illumination for the pitch blackness which is never penetrated by the light of the sun. District safety regulations require all underground workers to wear "hard boiled hats," or helmets, to protect their heads against falling rock fragments.

In addition to these "fighting tops," men working in wet sections are supplied by the District with firemen's heavy water-proof coats and rubber hip boots.

(Continued on Page 8)

CONSTRUCTION PROGRESS

July 16 to 31, 1938

TUNNEL (MILES)	EXCAVATION		LINING		CANAL, CONDUIT AND SIPHON (MILES)		DISTRIBUTION PIPE LINE (MILES)			
	Completed	Remaining	Completed	Remaining	Excavation	Completed	Remaining	Completed	Remaining	
Aqueduct	91.21	0.90	86.02	6.09	Excavation	145.60	0.01	Excavation	54.54	8.68
Distribution	16.25	0.42	16.21	0.42	Concrete	144.42	0.14	Concrete	54.30	8.92
Total	107.46	1.32	102.23	6.51	Backfill	80.70	0.14	Backfill	52.72	10.50

TUNNELS AQUEDUCT

CONTRACTOR	TUNNEL	LENGTH IN FEET	EXCAVATION IN FEET					LINING IN FEET					
			NUMBER OF SHIFTS	AVERAGE PER SHIFT	THIS PERIOD	TOTAL TO DATE	REMAIN- ING	ARCH OR INVERT	NUMBER OF SHIFTS	AVERAGE PER SHIFT	THIS PERIOD	TOTAL TO DATE	
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA	SAN JACINTO Cabazon Shaft to East Portal	8,880			Completed	8,880	0	{ Arch	0	0	*(426)	(36,673) (32,170)	
	Cabazon to Lawrence	26,809	42	7.6	319	24,158	0	Invert	0	0	0	8,484 396	
	Lawrence to Cabazon		42	6.7	281	2,651	0	{ Arch	0	0	0	6,973 19,836	
	Lawrence to Potrero		48	5.8	278	1,762		Invert	0	0	0	6,972 19,837	
	Potrero to Lawrence	17,672	48	3.5	167	11,143	4,767	{ Arch	1	44.0	44	5,681 11,991	
	Potrero Shaft to West Portal	15,482			Completed	15,482	0	Invert	12	40.8	489	6,112 11,560	
								Arch	0	0	0	15,482 0	
	TOTALS	Ft. Miles	68,843 (13.04)	180	5.8	1045 (0.20)	64,076 (12.14)	4,767 (0.90)	Invert	13	41.0	533	36,580 32,263
								Arch	0	0	0	37,050 31,793	

DISTRIBUTION

*Invert considered to equal 0.2 and arch 0.8 of completed section.

WEST CONSTRUCTION CO.	MONROVIA NO. 3	32,105		Completed	32,105	0				0	32,095	0	
J. F. SHEA CO., INC.	ROCKDALE (Schedule 21SC) OAKHILL (Schedule 21SC) ASCOT (Schedule 21SC)	262 597 1,622		0 0 0	262 0 1,622	0 597	Full Sec.	8	32.8	262	262	0	
	TOTALS	Ft. Miles	34,586 (6.55)		0	32,367 (6.13)	22.19 (0.42)	Full Sec.	8	32.8	262	32,357 (0.05)	2,219 (6.13) (0.42)

Canal, Conduit, Siphon and Pipe Lines

AQUEDUCT

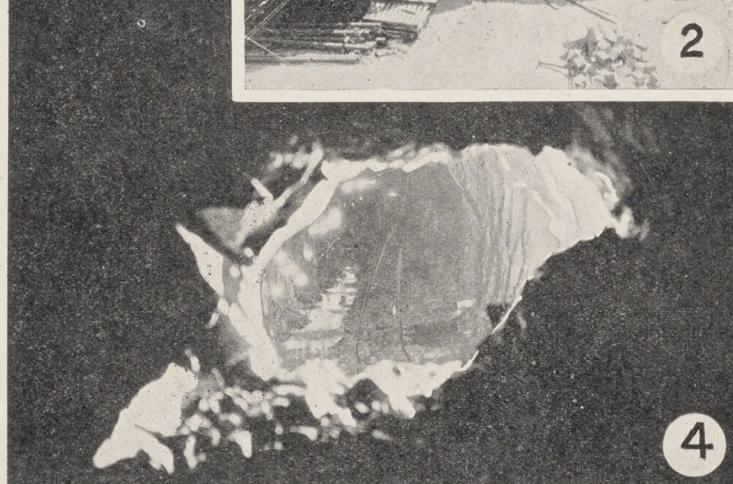
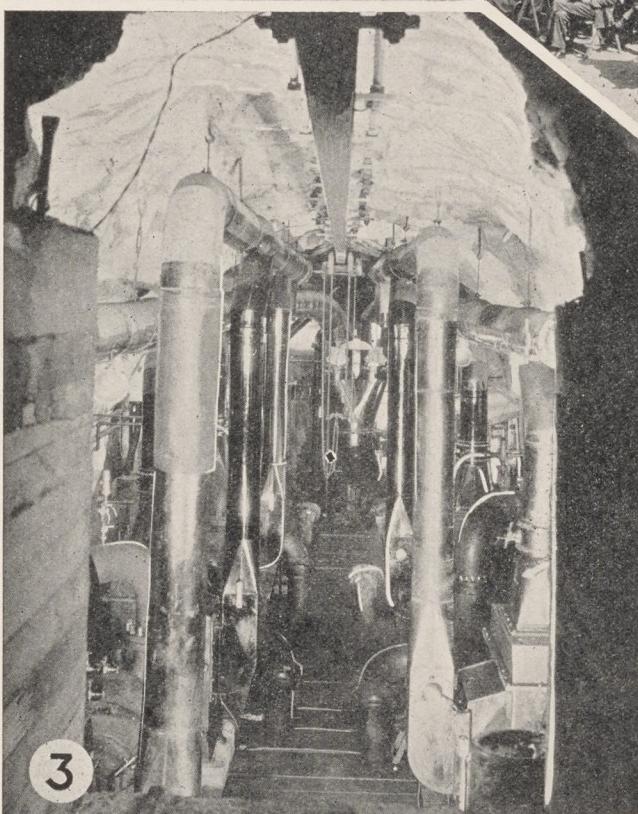
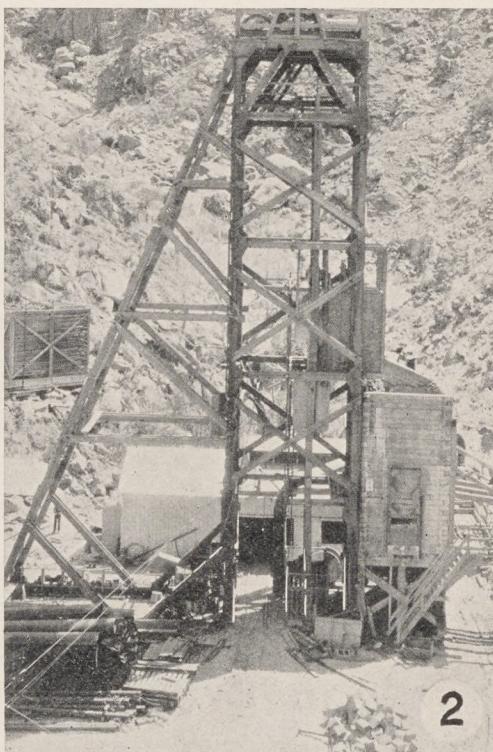
SCHED. NO.	CONTRACTOR	FEATURES	Length In Feet	EXCAVATION—Feet			CONCRETE—Feet			BACKFILL—Feet		
				Period	To Date	Remain'g	Period	To Date	Remain'g	Period	To Date	Remain'g
20 A & B	M. W. D.—FORCE ACCT.	Siphon	752	0	705	47	0	0	752	0	0	752
DISTRIBUTION PIPE LINES												
9-P	UNITED CONC. PIPE CORP.	Precast Concrete Pipe	8,697	283	8,697	0	94	8,482	215	0	7,863	834
8C-9C-12C	BASICH BROTHERS	Cast-in-Place Conc. Pipe	1,656	0	1,398	258	46	1,041	615	172	900	756
21SC			26,449	2,758	12,709	13,740	2,655	12,283	14,166	2,390	7,130	19,319
22SC			28,310	0	28,310	0	0	0	28,310	0	0	28,310
23SC	J. F. SHEA CO., Inc	Welded Steel Pipe	34,470	2,446	30,972	3,498	2,722	30,666	3,804	3,379	28,248	6,222
	TOTALS		99,582	5,487	53,776	45,806	5,517	52,472	47,110	5,941	44,141	55,441

Miscellaneous Construction

PARKER RESERVOIR—SIX COMPANIES, INC.					AQUEDUCT PUMPING PLANTS AND APPURTENANT WORKS				
FEATURES	Est. Quan.	Period	To Date	Per Cent.	PLANT	CONTRACTOR	PER CENT COMPLETED		
Diversion Tunnels—Excav.	3,463 Ft.	0	3,463	100			Excavation	100	100
Diversion Tunnels—Concrete	3,363 Ft.	0	3,363	100			Concrete	100	100
Cofferdams—Excav.	227,582 C.Y.	0	227,582	100	INTAKE	WINSTON BROS. CO. & WILLIAM C. CROWELL	Steel Erect'n		
Cofferdams—Fill	464,890 C.Y.	0	464,890	100	GENE				
Outlet Works—Excav.	220,000 C.Y.	0	207,935	100	IRON MT.	WOOD & BEVANDA			
Outlet Works—Concrete	5,000 C.Y.	0	5,286	100	EAGLE MT.	L. E. DIXON CO.			
Dam—Excavation	1,508,200 C.Y.	0	1,524,336	100	HAYFIELD	L. E. DIXON & CASE CONST. CO.			
Dam—Concrete	297,900 C.Y.	56	290,189	100					
Power House—Excav.	58,000 C.Y.	0	68,212	100					
Power House—Concrete	14,000 C.Y.	0	15,414	100					

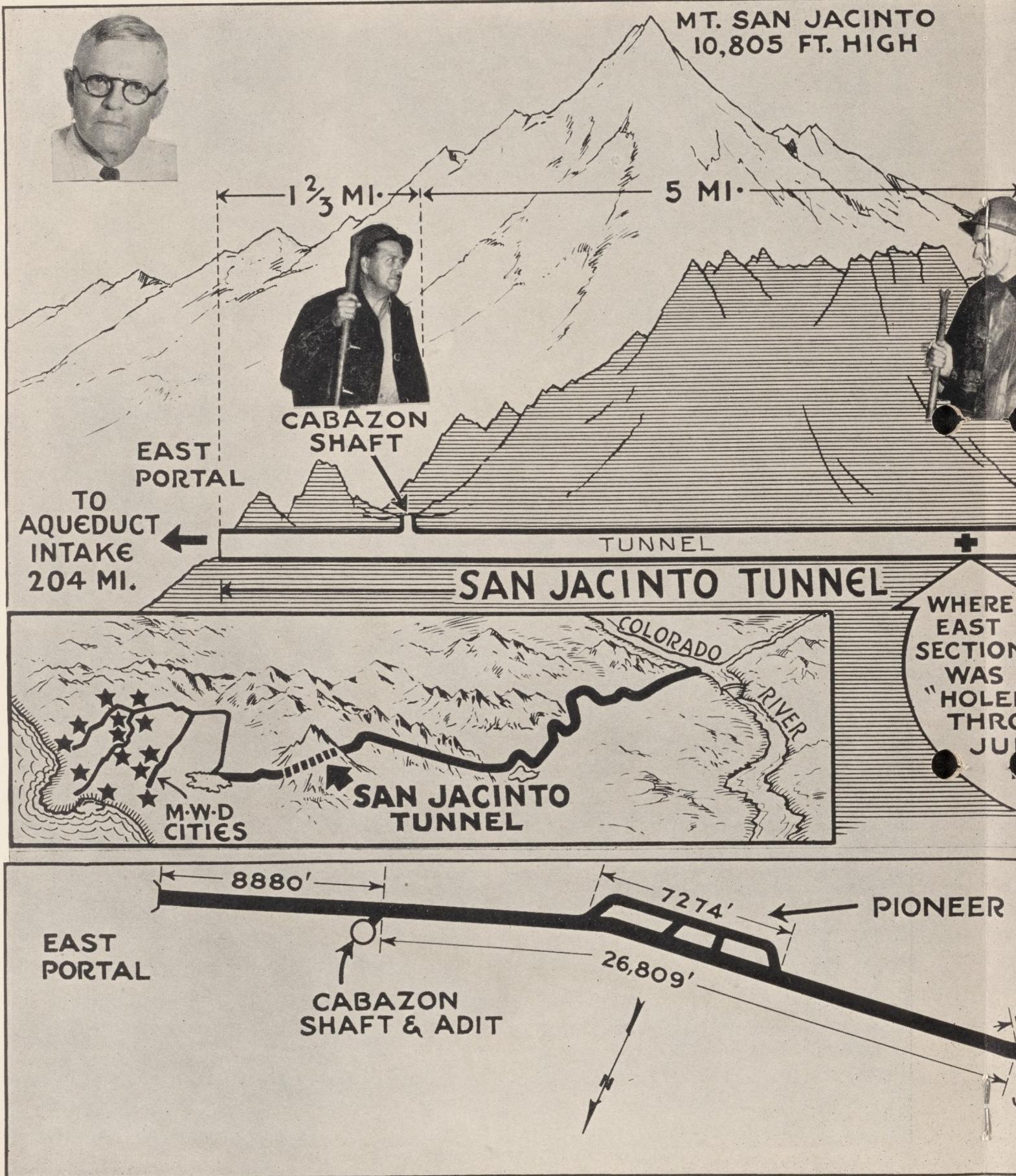
GENE WASH RESERVOIR—J. F. SHEA CO., INC.

FEATURES	Est. Quan.	Period	To Date	Per Cent.	FEATURES	Est. Quan.	Period	To Date	Per Cent.
Dam—Excavation	7,500 C.Y.	0	7,500	100	Dam—Excavation	8,700 C.Y.	0	8,700	100
Dam—Concrete	14,339 C.Y.	0	14,333	100	Dam—Concrete	18,000 C.Y.	0	17,986	100
Spillway—Excavation	4,762 C.Y.	0	4,762	100	Spillway—Excavation	8,137 C.Y.	0	8,137	100
Spillway—Concrete	4,729 C.Y.	0	4,729	100	Spillway—Concrete	2,050 C.Y.	0	2,050	100
Dike—Excavation	2,361 C.Y.	0	2,361	100	Outlet Works—				
Dike—Fill	8,710 C.Y.	0	8,710	100	Lump Sum	0		100%	100
Dike—Concrete	927 C.Y.	0	927	100	Clearing Reservoir Site	427 Ac.	0	427	100

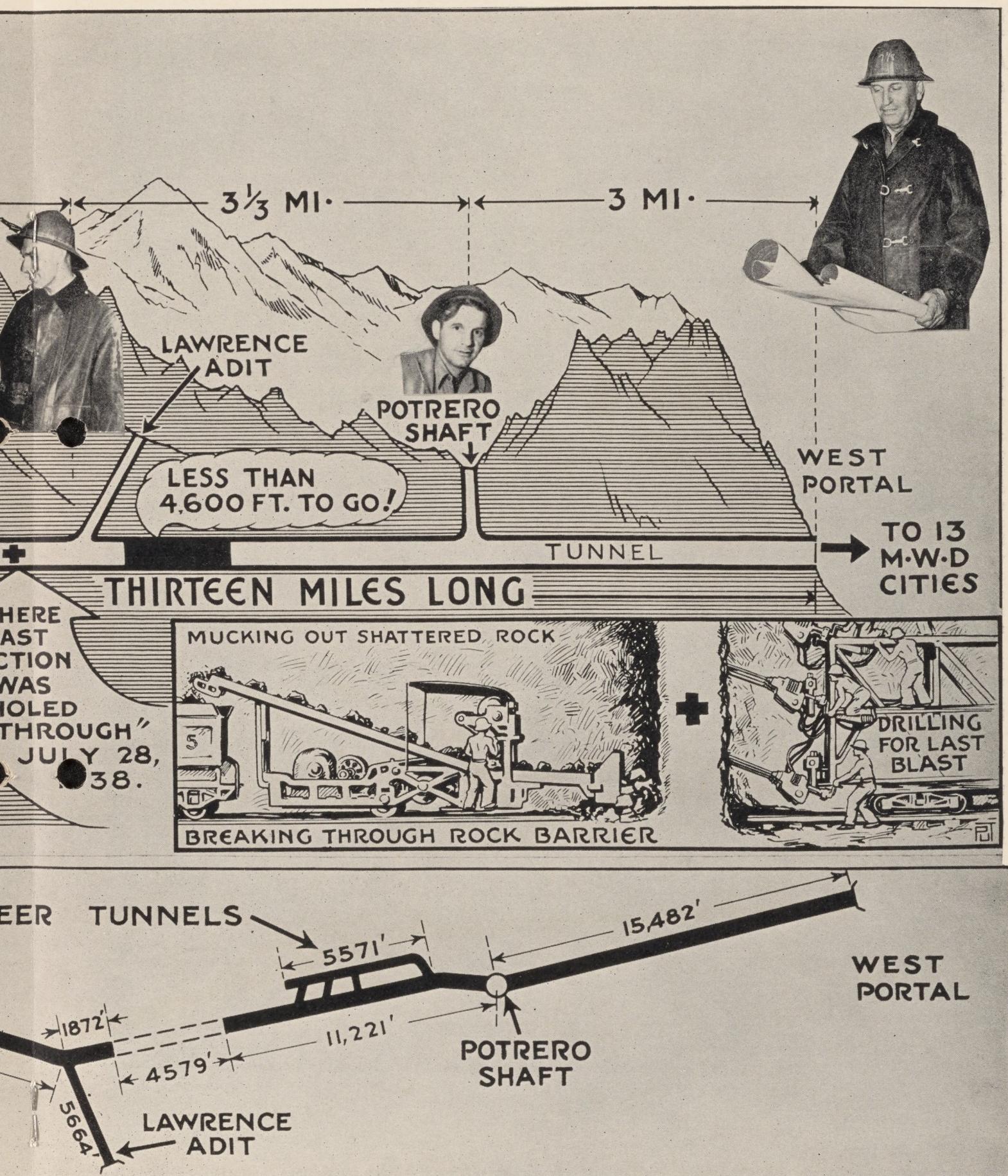


PROGRESS MILESTONES ON THE SAN JACINTO TUNNEL

1. Work begins. Progress Celebration, Cabazon, May 13, 1933.
2. Cabazon shaft headframe completed June 1, 1933.
3. Underground pump station completed at Potrero, June 14, 1935.
4. Potrero-West Portal holed through, February 21, 1936.
5. Excavation of Lawrence adit started, March 23, 1936.
6. Final round loaded for Cabazon-Lawrence hoing through, July 28, 1938.



The above sectional drawing and plan of the San Jacinto tunnel are self-explanatory. At the upper left is former Division Engineer J. B. Leadbetter. Crews are now working



Engineer J. B. Bond. From left to right at their respective camps are: Supts. C. E. Sides, John Austin, and Jack Shrode. In the upper right working on the remaining barrier between Lawrence and Potrero.

A Thirteen Mile Fight

(Continued from Page 3)

This equipment is the finest that can be purchased, and yet constant replacements are necessary due to the contact with sharp rock and pouring water.

In high pressure water, four to eight men may be required to change a drill steel. Holes at the bottom of the face must be drilled under water. Sticks of dynamite must be strapped to poles and the poles wedged into the drill holes so that the powder will stay in place long enough to be fired.

The greatest amount of water encountered at a working face was in East Potrero in the spring of 1938, where it reached a peak of 15,800 gallons per minute. Oddly enough, as though the old man of the mountain had found that even this didn't stop the crews, the heading almost immediately advanced into a dry section. So decided was this change that the front of the drill jumbo was completely dry, while the back end was being doused with 10,000 gallons of water per minute.

Fortunately these extreme conditions do not exist throughout the tunnel, and many thousands of feet have been driven through dry, or nearly dry, rock.

The water and bad ground are found in faulted and crushed zones. Each of these zones presents a different problem and many different methods have had to be evolved to get through them.

The section between the Potrero shaft and the West Portal was holed through on February 21, 1936, at a point approximately one mile west of the shaft. The 8,880-foot section east of the Cabazon shaft was holed out at the East Portal on September 5, 1936.

For the purpose of reducing the length of time required to excavate the tunnel, the District, in March, 1936, began the construction of an additional access point. This is known as the Lawrence adit, and is located approximately midway between the Cabazon and Potrero shafts.

This adit, which is a mile long, is built on a 25 per cent grade, and drops 1324 feet from its portal to its intersection with the line of the main tunnel. The adit was completed in December, 1937, three months ahead of schedule, and headings were immediately started east toward Cabazon and west toward Potrero. As reported in this issue of the NEWS, the Cabazon-Lawrence section was holed through on July 28, 1938.

About the same time that construction

of the Lawrence adit was decided upon, both the Cabazon and Potrero headings were in heavy going, and studies were made to determine the advantage of using pioneer tunnels paralleling the main tunnel. This was found to be practicable, and the pioneer was started at Cabazon on May 15, 1936, and at Potrero on June 22, 1936.

These pioneers are 10 feet square and were driven south of and parallel to the main headings, which by this time had both been angled north to intersect the Lawrence adit. In bad ground, these pioneers immediately proved their advantage. Being smaller, they were driven faster and thus were able to get considerably ahead of the main headings. This made it possible to explore the ground in advance and also to shoot cross drifts over to the line of the main tunnel, from which new headings could be put into operation.

This was particularly valuable on the Potrero side in crossing the Goetz fault, where the main heading (east) had been entirely stopped. By working west from the cross drift it was possible to hole through the faulted zone, which otherwise might have required many months to penetrate.

By July, 1937, the main heading at Cabazon had crossed all known major faults between Cabazon and Lawrence, and in August the Potrero main heading was able to keep pace with its pioneer. With both main headings in good ground it was possible to suspend pioneer operations, although all equipment is still maintained, ready for immediate use should heavy water flows or broken ground again make its use advantageous.

On August 13, 1937, a C. I. O. union demanded that the District's Board of Directors sign a contract covering 15 points, among which was the demand that the union be recognized as the sole bargaining agent for all men on the San Jacinto tunnel. The Board refused to sign the proposed contract, and the following day the union called a strike on the tunnel.

All of the men did not go on strike; 206 members of the crew stayed on the job, and the tunnel work was never closed down. The District immediately began to replace the strikers with experienced tunnel men, the largest part of whom had worked on other District tunnels, all of which had been excavated at that time. By the latter part of September all crews were back at full strength.

Today, even though the tunnel is not yet completed, it is impossible for the average visitor—unless he himself is a tunnel man—to realize the tremendous

odds that have been overcome in this battle against the mountain. As he speeds along on the tunnel train, mile after mile, his principal impression is of the seemingly unending length of the bore. The scars of battle have largely been covered over, for more than seven miles of the tunnel have already been lined with concrete and completed.

His guide may stop the train in an unlined section and point out giant timbers, 16 inches square and standing together "skin tight." Here a few months, or a few years, ago the heading was brought to a standstill—for a day or for weeks—while the hard-rockers battled water and heavy ground. Ground so heavy that it crushed 12x12 timber as though it were matchwood, and bent and twisted heavy steel ribs into grotesque shapes. It required the heaviest timbers available, standing together as tight as they would go, to hold the mountain in its place at such points.

A little farther along the train again stops in a quiet, deserted rock section. The visitor is told that this is good ground, and here the face was advanced 40 feet in a single day. Here the gray granite stands clean and unsupported, and the crews drove "full face" with eleven drills working on the front of the jumbo at one time.

Eleven drills working in a solid rock chamber, 18 feet square, and each drill making more noise than a machine gun. So much noise that the ear loses its sense of sound, and the whole body feels, rather than hears, the tremendous vibration of that sound.

On August 7, 1938, only 4579 feet of this tunnel remained to be excavated. The job is rapidly nearing completion. It is still a tough fight, and it is impossible to predict just what tricks the old man of the mountain may still have up his sleeve, and it is impossible to say on just what date the final holing through will take place.

The most important thing is that it will be finished at a reasonably early date. Truly remarkable progress has been maintained at all headings since February, 1935. Once again the sheafs of daily progress reports tell the real story—since the District took over the work the job consistently has gone ahead.

Mr. R. J. Cummins, consulting engineer for the Reconstruction Finance Corporation, summed up this fight of Man against Nature in a few words.

Speaking before the District's Board of Directors he said, "Your construction forces have conquered seemingly insurmountable obstacles in the construction of the San Jacinto tunnel."



1



2



3



4



5



6

ON THE JOB IN THE SAN JACINTO TUNNEL

1. Swing shift goes to work at Potrero.
2. Drill crew in the east face at Lawrence.
3. Mucking out, Lawrence West.
4. "Gandy dancers" at work in the Po- trero heading.
5. Beginning of a lined section.
6. Muck train at an underground siding in Potrero.

Design

Controlling Factors in the Location and Design of the Aqueduct

By JULIAN HINDS
Assistant Chief Engineer, M. W. D.

(Continued from July 25)

The costs of these conduit types vary about in the order named. Canals were used wherever possible, then covered conduits. Tunnels and siphons were used only where unavoidable.

The economic slope of each type was determined from cost estimates. Beginning at the established elevation at the San Jacinto Tunnel outlet and proceeding eastward, these slopes were added up back to the top of the nearest pump lift, at Hayfield, thus determining the peak elevation of 1807 feet above sea level. Although this peak is only 1357 feet above the elevation of the water in Parker Reservoir, a pump lift of 1617 feet is required to get the water there. The difference of 260 feet is used up in the slope of the intervening aqueduct.

It would have been desirable, if feasible, to do all the pumping at a single point, i.e., at the Intake. However, the desert floor, leading away from the river, is too low to support an aqueduct 1617 feet above the reservoir level. The ground rises gradually to Shaver's Summit, about 130 aqueduct miles west of the Intake. The pumping was divided between five plants and these were distributed along the line to secure the best possible fit between the aqueduct and the ground.

The first plant is at the river and the second one is nearby, the two having a combined lift of 594 feet, which is sufficient to deliver the water through the Whipple Mountain tunnels onto the tableland in the Vidal-Rice district, and cause it to flow 70 miles by gravity to the foot of Iron Mountain. Here a 144-foot lift provides head for flow through the Iron Mountain and Coxcomb tunnels and across the desert to Eagle Mountain. A fourth lift of 438 feet provides elevation for turning the corner of the mountains northwest of Desert Center and delivering the flow over a divide into the Hayfield Dry Lake area. This old lake bed is to be utilized as a natural reservoir. West of this reservoir, the terrain rises rather rapidly to Shaver's Summit, hence the fifth and last pumping plant is required. This plant lifts the water 441 feet to the peak elevation of 1807 feet. This elevation is somewhat higher than required to clear Shaver's Summit, but is necessary to provide the head needed to pass the controlling elevation at the San Jacinto Tunnel outlet.

West of San Jacinto the value of a foot of head is no longer related to the cost of pumping but is dependent upon the value of fall for the maintenance of flow in the remainder of the aqueduct, and the value of elevation in making deliveries to the various District cities. The value was somewhat smaller than for the eastern end of the line, hence siphons and tunnels were slightly reduced in size.

The availability of storage facilities was a further controlling factor in the location and design of the aqueduct. As the maximum demand is reached, it will be necessary to keep the aqueduct running at full capacity day and night, all the year, except for unavoidable interruptions. The result is a constant stream of water. But neither the supply of water at the Intake nor the demand at the outlet is naturally constant. The natural flow of the Colorado River is variable and the use of water is much lower in winter than in summer. If the aqueduct is to be used to full efficiency, a space must be available at both intake and outlet for storage.

Terminal storage is also required for safety. Any waterway as long as the Colorado River Aqueduct is subject to accident, due to earthquake, flood, or other natural cause. An interruption of as much as a month is conceivable. Although such interruptions will occur rarely, if ever, it is necessary that such a contingency be provided for by a reserve in local reservoirs. A reserve of two months' supply is about the minimum for safety.

The storage required at the intake is supplied by the Boulder and Parker reservoirs. The latter also serves to clarify the flow before its diversion into the aqueduct. Additional storage is required as near as possible to the end of the aqueduct.

Reservoir sites are very scarce in Southern California and generally expensive to develop. The storage possibility of every "wrinkle" in the topography of the coastal area was investigated. Many apparently possible sites were prospected. Convenience, safety of dams, cost of reservoir, and influence on aqueduct cost, were carefully considered. Finally, the Cajalco site, about ten miles southwest of Riverside, was chosen. This site is very safe and is capable of being developed in stages, as the demand for water grows. The reservoir is formed by an earthen dam across Cajalco Creek, and a long earthen dike along the north rim of the basin. The initial capacity is 100,000 acre feet, which can be increased as required to a total of 225,000 acre feet.

As an additional safeguard, and to reduce the capacity required in terminal lines, the District is to acquire Morris Reservoir on the San Gabriel River, as soon as Colorado River water is ready for delivery. This reservoir was built by the City of Pasadena. Other small operative reservoirs are contemplated. Use is also to be made of a natural lake bed at Hayfield about the middle of the main aqueduct, for additional emergency storage. This basin is west of all the open lined canal and will supply the aqueduct in case flow in the canal should be interrupted by cloudburst.

The solution of these general problems cleared the way for detailed location and design, which were controlled by consideration of safety, permanence, convenience, and economy, with safety in first place.

The element of safety is divisible into two parts, viz.: safety against damage to the public and safety against damage to the aqueduct. Where human life is involved, there can be no compromise whatever with safety. The Parker and Cajalco dams, for example, must have an excessive margin of safety, under the worst conditions imaginable. These features and others involving the safety of "life and limb" must be as safe as human ingenuity permits, regardless of cost.

(To Be Continued.)

MT. SAN JACINTO FIRST NAMED MT. SAN GORGONIO

Probably one of the most spectacular peaks on the entire Pacific slope, Mt. San Jacinto rises into the air more than two miles. Its base, back of Palm Springs, is nearly at sea level, while its towering peak is at an elevation of 10,805 feet above sea level.

Little is written in the history books about this mountain, although it seems probable that the first white man who could have seen it was Juan Bautista de Anza, who made a trip across the southern end of the Colorado Desert in 1774. A year later, Father Francisco Garces, the man who named the Colorado River, reported seeing two towering snow covered peaks, which from his description must have been Mt. San Jacinto and Mt. San Gorgonio.

The first white men to pass near the mountain were a party of Spanish soldiers lead by a Captain Romero and a Lieutenant Estrudillo in 1824. At that time, Mt. San Jacinto was known as San Gorgonio, and Mt. San Gorgonio was called Mt. San Bernardino. The two peaks were given their present designations at the time of the U. S. Land Office survey in 1853.

NEWS FROM FIELD AND OFFICE

The principal summer social event of the aqueduct season was the big party held at the Lawrence Bowl on the evening of July 30 to celebrate the Cabazon-Lawrence holing through.

More than two thousand aqueducters and their families attended this big party which, as was expected, was very much of a success. Again let it be stated, however, that the party did not tear down the Lawrence Bowl as a first glance on the morning after would seem to indicate (see picture).

The piece de resistance of the party was the award of prizes to the holders of the lucky tickets on the time of the holing through. A total of 1440 tickets was sold, each ticket representing one minute in a 24-hour day, the numbering starting at 12:01 A. M. The electric clock, which was wired to the firing switch so that it would be shut off at the exact instant the blast was fired, stopped at 10:28 P. M., which meant that the holder of ticket No. 1348 won the first prize of \$300.

The very thrilled holder of this ticket was Bessie Michealson, who works in the San Jacinto tunnel headquarters office at Banning. Miss Michealson has been with the District since December, 1936, having worked in the Medical Division both at Banning and Los Angeles before being transferred to the San Jacinto force. Bessie had the pleasure of being awarded the \$300 check, but, she had the even greater pleasure



Contrary to unfounded reports, this is not the result of the hardrocker's holing through party at the Lawrence Bowl on the night of July 30 - although this is the way the bowl looked the next morning. Authenticated reports from Banning state that the wreckage is due to a "twister" which tore down the building on Sunday morning, July 31.

Aqueduct Temperatures

July 16 to 31, 1938

	Max.	Min.
Div. 1	117°	79°
Div. 2	115°	80°
Div. 3	115°	79°
Div. 5	103°	61°



This very attractive smile may be due to using Whosis toothpaste, or again it may be due to the fact that Bessie Michealson was the winner of the \$300 first prize in the Cabazon-Lawrence holing through pool. The only fly in the ointment is the fact that Bessie, who works in the Banning office, had to split the \$300 with nine other people as explained elsewhere on this page.

of dividing it up with nine other aqueducters (it being more blessed to give than to receive). The reason for her generosity was because she and the other nine were community owners of the ticket which had been purchased in her name. Unphotographed, but nevertheless just as rich, were: Fred Carleton, Jessie Hoge, Hazel Clark, Arnold Hasle, A. E. McKinzie, Joe Edwards, Arthur O. Dahlke, V. F. Van Wye and Woody Wilson.

Six other aqueducters who held tickets with the nearest numbers to 1348 were also awarded cash prizes. These other winners, who, as far as is known, kept the money to themselves, were:

Bob Molinari, Lawrence, \$50; Stanley Kumlar, Lawrence, \$100; Vijo Doman, Lawrence, \$200.

A. S. Moore, Lawrence, \$200; Joe E. Brown, Banning Shops, \$100; and John C. Hewitt, East Portal, \$50.

Along with social activities, the San Jacinto tunneleers wound up a very successful baseball season on Aug. 2. Started in the late spring, the Hardrock Nite Ball League was made up of teams from Banning Headquarters, East Portal, Cabazon, Lawrence and Potrero.

The season was divided into halves, during which an average of two games per week was played at night on Kendall Field. Championship of the league was determined by a three-game playoff between the winners of the first and second halves of the season.

Winner of the first half was East Portal, after a playoff with the Banning Headquarters team. Potrero won the second half, although they too had to go into extra games to play off the series with Cabazon.

East Portal then won the championship by defeating Potrero in two straight games, scores being 20-12, and 14-13. East Portal's champions are: Gilmore Smalley (Capt.), Oscar Christensen, Sully Sullivan, Conrad Creim, Delbert Martin, Gale Wilson, Keith Riggan, Emmit "Bromo" Selzer, Ed Myers, Tom Walters, Wayne Stuht, Harry Black, Eddie Sickes, and Ted Jones (manager).



It is said that powder smoke has a strange affect on some people. Illustrating the point is this unposed flashlight picture of three victims, taken shortly after the Cabazon-Lawrence holing through blast. Left to right: Supt. John Austin, Assistant General Manager J. L. Burkholder, and General Superintendent B. C. Leadbetter.



JOHN G. BULLOCK
1871-1933.

John Gillespie Bullock was born January 14, 1871, in Paris, Ontario, Canada, the son of a railway employee. Two and a half years later his father died, and when he reached the age of eleven he found it necessary to leave school and secure employment as an errand boy in a grocery store. Later he entered the employ of the leading dry goods store of Paris. He had grasped the first rung of the ladder up which he was steadily to climb to the golden heights of business achievement.

Meanwhile, two of John Bullock's uncles had come to California. He decided that this, too, was his land of opportunity. In 1896 he arrived in Los Angeles. Here he found another former Canadian, Arthur Letts, operating a dry goods store. He secured a job in this store, and rapidly rose from one responsible position to another, until he stood at the head of the Letts merchandising organization.

In 1907, Mr. Letts opened a large department store at Seventh Street and Broadway, destined to rank among the best in America. At the head of this institution he placed John G. Bullock, and to the new store he gave the name of—Bullock's.

During the ensuing years the fame of Bullock's spread throughout the country. The name came to be recognized from coast to coast as the hall mark of commercial integrity and quality. During the passing years Mr. Bullock had become the principal owner of the great dry goods corporation which bore his name, a corporation with stores on Wilshire Boulevard, in Palm Springs and Westwood, in addition to the original location at Seventh, Broadway and Hill.

During the first three decades of the twentieth century Los Angeles amazed the world with its growth in population

WORLD'S LONGEST TUNNELS

Name	Location	Length in Miles	Purpose
Hetch Hetchy-Coast Range	California	25.0	Water Supply
City Tunnel No. 2	New York	20.2	Water Supply
*East Coachella	California	18.3	Water Supply
Shandacken	New York	18.13	Water Supply
City Tunnel No. 1	New York	18.11	Water Supply
Ben Nevis	Great Britain	16.0	Water Supply
Cold Brook-Wachusett	Massachusetts	14.0	Water Supply
*San Jacinto	California	13.04	Water Supply
Florence Lake	California	12.82	Hydro-Elect.
Simplon	Switzerland	12.4	Railroad
Milwr	North Wales	12.0	Drainage
Chicago Avenue	Illinois	12.0	Water Supply
Hetch Hetchy-Mountain	California	11.5	Water Supply
Apennine	Italy	11.5	Railroad
Mono Craters	California	11.33	Water Supply
Munich	Germany	11.18	Water Supply
Quabbin	Massachusetts	10.6	Water Supply
Joseph II	Hungary	10.28	Mining Adit
Jersey City Tunnel	New Jersey	10.25	Water Supply
Hetch Hetchy—Foothill	California	10.1	Water Supply
St. Gotthard	Switzerland	9.31	Railroad
Loetschberg	Switzerland	9.03	Railroad
Mont Cenis	France-Italy	7.98	Railroad
New Cascade	Washington	7.78	Railroad
*Iron Mountain	California	7.53	Water Supply
*Valverde	California	7.20	Water Supply
Harlem River	New York	6.83	Water Supply
Moffat	Colorado	6.11	Railroad
Arlberg	Austria-France	6.11	Railroad
*Whipple Mountain	California	6.11	Water Supply
*Monrovia No. 3	California	6.08	Water Supply
Gunnison	Colorado	5.8	Irrigation
Elizabeth Lake	California	5.09	Water Supply
Rogers Pass—Connaught	British Columbia	4.91	Railroad
Hoosac	Massachusetts	4.75	Railroad

Six of the 31 longest tunnels in the world are on the Colorado River Aqueduct (indicated by asterisks).

and its commercial expansion. There were many business men content to reap the trade benefits of this growth, and let it go at that. John Bullock was not of that breed. He knew the full possibilities and the limitations of Southern California. He knew that these possibilities and limitations were bounded by just one basic necessity—Water.

A few civic leaders had launched the ambitious program of securing an additional supply of water from the Colorado River. Certain private interests bitterly opposed the program. They fought it desperately and sought to arouse public sentiment against the proposal. Few business men were willing to hazard the ill will of customers and creditors in such a battle. John Bullock did not hesitate. He threw the full weight of his name and his influence on the side of the Colorado River development program.

In 1929, shortly after the organization of the Metropolitan Water District, Mr. Bullock was appointed one of the directors for the city of Los Angeles. From the date of his appointment to the day of his death, he remained one of the dominant leaders of the Board of Directors. He was made Chairman of the Board's committee on public relations, and as such he directed, in behalf of the Board, the campaign of education which preceded the voting of the \$220,000,000 aqueduct bond issue by the

decisive majority of five to one.

The bonds were authorized by the people in September, 1931. But the black days of the depression had wiped out the private market for every sort of security. Together with two or three associates in the District, Mr. Bullock journeyed to Washington, D. C., and went before the R. F. C. It was his sound business judgment and unqualified support that went far in securing a pledge from the R. F. C. to buy the District's bonds.

John Bullock was proud of his association with the District. The people of the District may well be forever thankful for the tremendous public service rendered by this man who was, in the noblest sense, a Merchant Prince.

D. J. K.

CABAZON-LAWRENCE HOLED THROUGH ON JULY 28

(Continued from Page 2)

its roost on the top of Mt. San Jacinto, and sent the word down that both crews would participate in the holing through. As a result the official report reads:

"The last blast consisted of a 21-foot 8-in. double round, drilled and loaded from both headings, but with all lead wires connected to the Lawrence firing line from which it was shot. At 10:28 P. M., the long round broke clean and close to line and grade."